DEVELOPMENT OF A CONCEPT-BASED SPORTS NUTRITION CURRICULUM

By

MELISSA MOORE SHOCK

Bachelor of Science
University of Arkansas
Fayetteville, Arkansas
1970

Master of Science
University of Central Arkansas
Conway, Arkansas
1984

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
May, 1992

DEVELOPMENT OF A CONCEPT-BASED

SPORTS NUTRITION CURRICULUM

Thesis Approved:

Margaret L Callen
Thesis Advisor

Elaine Jorgensen

Bernice Kopel

P. L Claypool

Thomas C. Collins
Dean of the Graduate College

ACKNOWLEDGEMENTS

Special thanks is given to my family for their continual support and patience during all phases of this project. Also, to Dr. Elaine Jorgenson, Dr. Margaret Callsen, Dr. Bernice Kopel, and Dr. P.L. Claypool for their encouragement and advice through the project.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

The discipline of sports nutrition is slowly unfolding as more questions are answered regarding the nutritional requirements of sports performance (Grandjean, 1989b). Studies of dietary practices and nutrition knowledge of athletes reveal problems with erroneous nutrition knowledge and food faddism (Douglas and Douglas, 1984). Frequently, coaches, trainers, and team physicians dispense misleading nutrition information (Short and Short, 1983).

Douglas and Douglas (1984) reported a positive relationship between the number of seasons of sports participation and nutrition knowledge, indicating that sports participation may be a catalyst for learning about nutrition. The increasing interest in wellness has also encouraged the recreational athlete to focus on nutrition in attempting to maintain or achieve good health. Nutrition educators are urged to communicate nutrition facts to athletes in order to encourage better nutritional practices. Due to interest in the subject and the need for factual information, sports nutrition has become a challenge in nutrition education.

In order to meet the needs of the consumer of sports nutrition, the inclusion of sports nutrition in the home

economics curriculum requires examination. Curriculum considerations include societal trends and issues, their appropriateness in relation to the conceptual structure of the field, and the level of development of the field of study (Home Economics Concepts: A Base for Curriculum Development, 1989).

Curriculum development requires that topics be selected and arranged in order to achieve the desired goals. Various methods of curriculum development may be utilized in the planning process. One method, conducting research on appropriate topics for sports nutrition, may provide a conceptual framework as utilized in the concept-based theory of curriculum development. Along with topic identification, research focused on effective methods of educating students about sports nutrition is needed (Potter and Wood, 1991). In order to investigate appropriate topics and learning activities in sports nutrition, members of the Sports and Cardiovascular Nutrition practice group of the American Dietetic Association were surveyed.

Statement of the Problem

In search of the competitive edge, athletes frequently fall prey to nutrition fads. According to Kris-Etherton (1990), there is an urgent need to develop effective programs that provide accurate nutrition information to sports enthusiasts as well as coaches or parents of athletes. Sports participation may, therefore, provide a vehicle for effective nutrition education which could have

long lasting effects. Brotherhood (1984, p. 351) summarizes the importance of nutrition in the daily lives of athletes.

> Correct nutrition is essential to both the immediate and future health and performance of the athlete. Achievement in sport may be a powerful motivator for the individual to adopt sensible living habits that will be retained throughout life.

Effective methods of delivering nutrition messages must be developed in order to facilitate the delivery of sound dietary recommendations (Graves, Farthing, Smith, and Turchi, 1991). The development of educational strategies geared toward decreasing dietary problems common to athletes is recommended (Corley, Demarest-Litchford, Bazzarre, 1990). Gillespie (1987) reinforces this concept by indicating that the more narrowly focused a nutrition message, the more effective it will be.

Identification of the appropriate topics for sports nutrition may provide guidelines for future educational programs. Development of communication strategies for changing behavior may rely on the use of effective methods of teaching. The concept-based curriculum theory, as outlined by Bruner (1966), provides the theoretical foundation for research in these areas.

Purpose and Objectives

The purpose of the study was to identify topics appropriate for a curriculum in sports nutrition. Such a study could provide the nutrition educator with a conceptual framework for curriculum development in home economics.

Members of the Sports and Cardiovascular Nutrition practice group (SCAN) of the American Dietetic Association were surveyed for their input. The respondents were asked to rate the importance of a listing of topics to be included in a sports nutrition curriculum. Ratings ranged from essential to not important.

The identification of learning activities in sports nutrition was a second goal. Learning activities help with internalization of the subject matter. The research objectives follow.

1. To identify topics appropriate for a sports nutrition curriculum.
2. To identify the five topics for a sports nutrition curriculum which ranked highest.
3. To assess the perceived importance of the topics identified for a sports nutrition curriculum as associated with the level of education, the recency of education, and the type of primary employment of the respondents.
4. To identify learning activities for teaching sports nutrition as recommended by the respondents.
5. To develop recommendations for a sports nutrition course.

Hypotheses

The following null hypotheses were tested.

H1: There will be no significant difference between the importance of the topics identified for a sports nutrition curriculum as associated with the level of education of the respondents.

H2: There will be no significant differences between the levels of importance of the topics identified for a sports nutrition curriculum as associated with the recency of education of the respondents.

H3: There will be no significant difference between the levels of importance of the topics identified for a sports nutrition curriculum as associated with the current employment of the respondents.

Assumptions, Limitations, Definitions

Assumptions

It was assumed that the respondents, members of the Sports and Cardiovascular Nutrition practice group of the American Dietetic Association, have a knowledge of the nutrient needs of sports participants. The dietetic practice group is identified as a group of professionals with skill, knowledge, and practice in the field of sports nutrition (Clark, 1991).

The mission of the dietetic practice group is to provide leadership in promoting the role of nutrition in physical performance, cardiovascular health, and wellness (Clark, 1991). Therefore, it is assumed that the members are active in advising and implementing nutrition programs in the field of sports nutrition. The respondents, therefore, should be qualified to identify topics and learning activities.

Limitations

Participation in the study was dependent upon response to a mailed questionnaire. Therefore, as stated by Best and

Kahn (1986), a limitation to the results may be due to the number of responses.

Diversity of meaning attributed to a question by respondents is a second limitation (Touliatos and Compton, 1988). Interpretation of questions may pose a limitation to responses.

With a low rate of return to a mailed questionnaire, a bias may be created, as the sample ceases to be random (Joseph and Joseph, 1986). Other limitations include the fact that the data are confined to the respondents' answers, and there is no opportunity to try for additional data.

Definitions

1. Sports nutrition focuses on the relationship between diet and physical performance, including the nutritional stresses associated with sports activity.
2. The American Dietetic Association (ADA) is the professional organization for dietetic practitioners (Directory of Dietetic Programs 1991-1992, 1991).
3. SCAN is the abbreviation used by the Sports and Cardiovascular Nutritionists, a dietetic practice group of American Dietetic Association.
4. Didactic program in dietetics provides for the achievement of knowledge requirements for entry-level dietitians, culminating in a minimum of a baccalaureate degree and followed by the internship experience at an approved site (Accreditation/Approval Manual for Dietetic Education Programs, 1991).

5. Skill areas in dietetics defines the internship or equivalent experience, obtained after completion of the didactic program in dietetics, in preparation for the qualifying exam.

6. Registered Dietitian (RD) refers to the member of the American Dietetic Association who has completed at least a bachelor's degree, an internship or equivalent experience, and a qualifying examination (Member Handbook, 1990).

7. Ergogenic aids is a term for substances, techniques, or equipment used to enhance performance by improving energy production, energy control, or energy efficiency during exercise (Williams, 1991).

Research Procedures

The identification of appropriate topics and recommendations for learning activities in sports nutrition was the basis for this research project. The theoretical foundation of a concept-based curriculum provided impetus for the project. The study was an example of descriptive research, utilizing a mailed questionnaire as the instrument.

Population and Sample

The population in the study were members of the Sports and Cardiovascular Nutrition (SCAN) practice group of the American Dietetic Association. The

population consists of 3700 members. A random sample of 361 members was taken from the membership directory. Each member drawn into the sample was mailed a questionnaire.

The American Dietetic Association (ADA) is the professional organization for dietetic practitioners. The purpose of the Association is the promotion of optimal health and nutritional status of the population through the provision of direction and leadership for quality dietetic practice, education, and research (Directory of Dietetic Programs, 1991).

ADA members, with extensive scientific backgrounds, apply knowledge of food, nutrition, biochemistry, physiology, management, behavior, and social sciences to promote health, prevent disease, and speed recovery from illness (Member Handbook, 1990). Most ADA members are also registered dietitians (RD), and have completed at least a bachelor's degree, an internship or equivalent experience, and a qualifying examination. Continuing education is required to maintain the RD credential. This education is frequently provided by dietetic practice groups.

Dietetic practice groups, an integral part of ADA, provide the practitioner with the opportunity to share experiences with colleagues in the same area of practice. Providing continuing education within the area of specialization is an essential part of the goal of each dietetic practice group. There are 23 dietetic practice groups in ADA, with SCAN falling under the division of clinical dietetics in the organizational chart of ADA. Other dietetic

practice groups are in the divisions of community dietetics, consultation and private practice, management practices, and education and research (Member Handbook, 1990). SCAN members educate the public about aspects of sports, cardiovascular, and wellness nutrition which promote healthier lifestyles.

Instrumentation

The questionnaire used, Sports Nutrition Curriculum Survey, requested demographic information as well as recommendations for sports nutrition in the curriculum. The respondents were asked to rank both appropriate topics for sports nutrition and learning activities (Appendix A).

The instrument was developed specifically for the project after an inconclusive search for an appropriate instrument. A pilot study was conducted, establishing content validity. Registered Dietitians were asked to review the questionnaire, making recommendations for change.

In conclusion, the project utilized a mailed questionnaire designed to identify appropriate topics for a sports nutrition curriculum. Such a curriculum design is an example of a concept-based curriculum, as advocated by Bruner (1966). Information about placement in the curriculum, prerequisites, and learning activities was also requested.

CHAPTER II

REVIEW OF LITERATURE

Education is a dynamic and complex process that translates the theoretical and ideal into actual application and practice (Accreditation /Approval Manual for Dietetic Education Programs, 1991). Developing educational plans in home economics requires screening curriculum as an on-going process with continuous questions (Anderson and Brands, 1990). Planning a curriculum begins with the preferred theoretical foundation.

Curriculum Theory

Three major curriculum approaches are described in Home Economics Concepts: A Base for Curriculum Development (1989): concepts and generalizations, competency-based, and practical problem-based. The role of each, as used in home economics, is described briefly.

Concepts and generalizations focus on organization and communication of content. A conceptual outline is developed for each level of the curriculum. Generalizations review and summarize the concepts.

The competency-based curriculum focuses on the organization and communication of expectations. Tasks, competencies, behaviors, learner outcomes, and valued

ends are specified (Anderson and Brands, 1990). A conceptual framework can be used with this method, however, performance objectives stating the conditions for task performance and the standard for performance criteria are included.

The practical problems theory of curriculum organizes learning experiences and communicates the process of learning, focusing on critical thinking. Learning activities are designed to focus on the process of learning. Students are urged to compare claims or arguments, weigh evidence, and form conclusions based on sound reasons rather than authority, expediency, whimsy, tradition, or irrational compulsion (Brown and Paolucci, 1979).

Concept-Based Curriculum

For development of the sports nutrition curriculum, the theory of a concept-based curriculum is used. Proposed by Jerome Bruner in the 1960's, the curriculum components are identified and sequentially arranged, forming a conceptual framework of key ideas to be learned.

Concepts are defined as "abstractions representing the world of objects and events and as a means of organizing them" (Concepts and Generalizations, 1967, p. 23). Concepts may be themes which occur throughout the curriculum in a cumulative and often overlapping way. Concepts may be written as nouns or noun phrases in formulating an overview of a program (Anderson and Brands, 1990).

Subconcept refers to a secondary, subordinate component of a major concept (Home Economics Concepts: A

Base for Curriculum Development, 1989). Subconcepts provide a method of further delineating the curriculum content. Subconcepts may replace generalizations. Sequencing of concepts in a cognitive manner, is recommended by Bruner (1966). Following a hierarchical pace, concepts are arranged in order to facilitate higher levels of learning as one proceeds through the curriculum. Subconcepts can be used to review and summarize, helping the learner to assimilate the information covered.

Such sequencing of concepts allows the learner to utilize feedback from first experiences with a concept as learning occurs at higher levels of the taxonomy. Personal experiences enable the learner to internalize the information. Therefore, "the more varied and continuous experiences an individual has, the broader, more complex and/or meaningful the concept may become" (Home Economics Concepts: A Base for Curriculum Development, 1989, p. 50).

Concept Identification

The concept-based theory of curriculum development allows the researcher to determine "what is warranted and meaningful in a field of study" (Home Economics Concepts: A Base for Curriculum Development, 1989, p. 50). Concept identification is necessary in the analysis stage of curriculum development. It can provide a structural framework for writing objectives, planning learning activities, and developing evaluation criteria. Consideration of both the

means and the ends is required in the analysis stage (Hannay and Seller, 1991).

Potential sources of information in identification of curriculum concepts include learners, social conditions, and subject matter specialists, according to Bruner (1966). Learners in sports nutrition are identified as athletes or individuals working with athletes. Athlete may be defined as the individual in a structured, competitive program, or a recreational athlete who is physically active in individual or group activities.

Social conditions affecting curriculum decisions in sports nutrition include the importance of nutrition in health, as elucidated by The Surgeon General's Report on Nutrition and Health (1988). Several of the leading causes of death in America are related to nutrition, many due to inappropriate dietary patterns. Surveys of dietary intakes of athletes reveal such dietary patterns, making them a target group for education (Short and Short, 1983).

Subject matter specialists in sports nutrition are identified as individuals with specialized knowledge, such as SCAN members. Jerome Bruner (1966) refers to the use of subject matter specialists in the concept-based curriculum model which relies on the structure of a subject or the fundamental principles as the method of designing the curriculum.

Variations in recommendations by subject matter specialists may occur with specialized training, such as that

required for the RD, years of experience, and type of employment. Recency of education may also be reflected in the subject matter specialists' opinions (Oliva, 1988). Other subject matter specialists may include professionals in curriculum development.

Curriculum Design in Dietetic Education

Utilization of Bruner's curriculum model is evident in dietetic education. Throughout its history, the dietetic curriculum has been based on recommended academic requirements as set by the American Dietetic Association. Current standards of education reflect results of the 1989 Role Delineation Study on expected practice standards. Programs are encouraged to continually update curricula based on current practice (Accreditation/Approval Manual for Dietetic Education Programs, 1991).

Dietetic education must provide opportunities, including real life experiences, for students to acquire the knowledge and skills for dietetics. Once the didactic portion of the dietetic curriculum is complete, an internship component fosters development of skill areas. The curriculum must reflect practice standards. Thus, the discipline of dietetics establishes the criteria for curriculum development in dietetic education.

Placement of Sports Nutrition in Curriculum

Placement of sports nutrition in the dietetic curriculum requires attention to sequencing. It may actually need

to be introduced through a basic nutrition course, enabling students to apply the elemental concepts when focusing on nutrition and the athlete.

Current research, such as the Sports Nutrition Curriculum Survey, may add credibility to future curriculum plans based on the responses of practicing professionals. As input from professionals is used in designing the performance criteria in dietetic education, similar input may be valuable in the formulation of the sports nutrition curriculum.

Identification of Concepts

Prioritization of curriculum topics must begin with defining the purpose and reviewing potential topics. Sports nutrition focuses on three areas: nutritional maintenance and development during athletic training, with adequate recovery between training sessions; precompetition preparation; and nutrition during athletic competition (Brotherhood, 1984). Therefore, the topics appropriate for sports nutrition begin with the principles of normal nutrition. Williams (1989, p. 10) summarized the importance of normal nutrition in teaching athletes.

> Nutrition education of the athlete should be one of the basic principles of training, for a balanced intake of all nutrients will help to ensure optimal performance.

Brotherhood (1984) echoes these sentiments with recommendations that the best diet for an athlete is the same diet for all healthy individuals. The principles of normal

nutrition, therefore, are applicable to the athlete or the individual involved in recreational exercise.

From the standpoint of the needs of normal nutrition, the six classes of nutrients provide a sound starting point in identifying curriculum concepts in sports nutrition. Carbohydrate, protein, fat, vitamins, minerals, and water are the six classes of nutrients, with a few changes in recommendations during exercise.

Carbohydrate Needs During Exercise

Carbohydrates are the key nutrient in exercise, as blood glucose and stored glycogen are available as energy sources. Because carbohydrate is more readily available than protein or fat during exercise, more carbohydrate should be consumed. Recommended amounts of carbohydrate range from 50% to 70% of kilocalories daily for athletes.

Brotherhood (1984) states that endurance is enhanced after consuming a diet rich in carbohydrate, while performance is reduced with a diet high in protein and fat. Similar reports by O'Keefe, Keith, Wilson, and Blessing (1989), illustrate that low carbohydrate diets (13% of calories consumed) are generally of an adverse nature and can be considered detrimental to training and performance. The ability to sustain either repeated or continuous high intensity exercise is entirely dependent upon the glycogen content of the muscles involved (Brotherhood, 1984). Therefore, with a mismatch between exercise intensity, duration

and carbohydrate intake, glycogen depletion will occur, resulting in premature deterioration of performance. Several studies have confirmed this fact.

Affirming this theory is a study of female cyclists who rode significantly longer while consuming moderate and high carbohydrate diets as compared with low carbohydrate diets (Keith, O'Keefe, Blessing, and Wilson, 1991). Subjects consumed 13%, 54%, and 72% of their kilocalories from carbohydrate while on the low, moderate, and high carbohydrate diets, respectively. Plasma glucose values of the cyclists were normal and did not differ among the three diets.

The importance of carbohydrate in the diet of physically active individuals appears indisputable, however, surveys of dietary practices reveal inconsistent practices among athletes. Hickson, Wolinsky, Pivarnik, Neuman, Itak, and Stockton (1987) reported carbohydrate intake at 39% of total caloric intake in a 3-day food consumption study of football players. The study included sixteen male collegiate football athletes (8 blacks, 8 whites) who played in a lineman position. Conducted during the winter stage of conditioning, the subjects were participating in one hour of weight training and one hour of distance running and sprint training four to five times per week.

Dietary intake data was collected by the investigators. The subjects were dining in a training table situation, therefore, the investigators accompanied the athletes to meals, weighing food choices on the electronic balance.

Plate waste was visually estimated except for meats where the refuse (bones and meat) was weighed. Snacks were reported to the investigators by the athletes. Dietary intake was analyzed by a custom-designed computerized system.

The overall mean daily energy intake was 3593 kilocalories, with the major energy source coming from meat. The major source of carbohydrate included foods from the fat, sweets, and beverages group, especially sugar-sweetened soft drinks. Grain products were the second leading source of carbohydrate. Carbohydrates and fats provided equal percentages (39%) while protein provided 22% of the energy intake.

Brotherhood (1984) calculated a 46% carbohydrate intake by athletes in a summary of dietary intakes of athletes as reported by a variety of researchers. Included in the summary were studies from 1970 through 1983 from research taking place in various parts of the world.

Updegrove and Achterberg (1991) report that athletes lacked knowledge about the role of carbohydrates in the diet. Their study of athletes was conducted with regard to the role and value of food, eating, and nutrition as they pertain to training. Results indicated that the importance of carbohydrate in exercise should be emphasized in nutrition education of athletes.

Evans and Hughes (1985) state that most athletes are confused about what form of dietary carbohydrate is best, when and how much should be consumed, and how dietary carbohydrate, or a lack of dietary carbohydrate, will affect

their performance. Therefore, the inclusion of carbohydrate metabolism as well as food sources of carbohydrate appears to be essential in planning the sports nutrition curriculum.

Fat as Energy

In exercise, the energy nutrient fat, stored as triglycerides in the adipose tissue, is mobilized to provide free fatty acids (Brotherhood, 1984). The free fatty acids are released into the blood and transported to muscle cells. Triglycerides may also be stored within muscle cells. Fat stores within a normal, healthy person provide a large and fairly constant reservoir of energy. Utilization of the fat reserves increases as exercise proceeds; in prolonged moderate exercise, fat may be the predominant fuel (Essen, 1977).

Dietary fat intake is necessary, however, precautionary measures are urged in consideration of types of fat consumed. Saturated fat and cholesterol have been associated with increased health risks (The Surgeon General's Report on Nutrition and Health, 1988). Fat intake of athletes has been found to be extremely high in some cases, particularly that of football players. Short and Short (1983) reported 38% to 42% of kilocalories originating from fat in athletes' diets. Incidences of athletes consuming as much as 20 pats of butter plus one cup of gravy were reported. Lukaski, Bolonchuk, Klevay, Mahalko, Milne, and Sandstead (1984) indicated that even athletes who were training vigorously can have their serum cholesterol and high-density lipoprotein cholesterol negatively affected by a high-fat diet.

Protein as Fuel

The most controversial energy nutrient in sports nutrition is protein. The myths surrounding the need for protein intake, including amino acid supplements, have led many athletes to overindulge in protein foods in hopes to build muscle. The fact that protein is essential in building tissue has been distorted in the views of many athletes. There is evidence that dietary protein needs may increase with regular training (Houck and Slavin, 1991). Studies indicate that the requirement for protein for athletes may be between 0.94 g/kg of body weight and 2.0 g/kg of body weight (Houck and Slavin, 1991). However, confounding variables in several research studies lead researchers to question recommended protein intakes. These variables are timing of sampling relative to initiation of an exercise program (training), energy and protein intake associated with activity, and intensity of exercise performed (Butterfield, 1987).

The effect of protein needs may depend upon the time elapsed between initiation of an exercise program and sample collection (Yoshimura, Ionue, Yamada, and Shiraki, 1980). Increase in protein breakdown was illustrated as a statistically significant decline in serum albumin and hemoglobin concentrations in young men 10 days after initating a moderate cycling program. The authors theorized that the blood proteins were catabolized in response to exercise, and the constituent amino acids were reused to synthesize

new muscle tissue. Therefore, data collected during the adaptation period may suggest an increased need for protein yet data collected after adaptation may suggest an unchanged or decreased protein need. Further studies in the area of protein and training are needed.

Energy and protein intakes associated with activity, show that the utilization of even a marginal intake of protein will be improved, giving the appearance that protein intake is adequate. Butterfield and Calloway (1984) showed that nitrogen balance was improved by increasing exercise time even when nitrogen intake was marginal. When energy intake and output were balanced, the improvement in nitrogen retention accomplished by exercise seemed to be fairly constant but fell off rapidly at protein intakes below needs.

With respect to intensity of exercise, Lemon, Dolny, and Yarasheski (1984) suggested that variations in protein recommendations may result from a variety in the intensity of the exercise performed. They varied intensity of a one-hour treadmill exercise from 42% to 67% of maximum oxygen consumption in trained individuals. Urinary urea production was monitored before, during, and for the two days following the exercise. At 42%, urea did not increase. However, at 55% and 67%, there was an increase. Energy intake was not modified, therefore, the change in nitrogen excretion may be due to energy imbalance or the exercise itself.

Studies of actual protein intake of athletes reveal that the average athlete in the United States consumes

protein in the highest recommended ranges (Short and Short, 1983). Very few athletes need additional protein. However, it is suggested that assessment of the athlete's calorie and protein intake accompany any dietary recommendations. Individuals at highest risk for inadequate protein intake may be those consuming energy restricted diets or high-carbohydrate diets or athletes engaged in multiple daily training sessions (Houck and Slavin, 1991).

Vitamins in Exercise

Many athletes believe that supplementation of specific vitamins and minerals enhances physical performance, providing the competitive edge. Ergogenic properties are often ascribed to these nutrients (Whitmire, 1991). The importance of vitamins and minerals in human nutrition is well-recognized, however, their roles in exercise is less clear.

Water-soluble Vitamins. Water-soluble vitamins, including the B complex vitamins and Vitamin C, need to be consumed daily. Several of the B-complex vitamins, including thiamin, niacin, and riboflavin, are involved in energy release, therefore, they are popular supplements among athletes. Among research studies, however, requirements for increased amounts during exercise have not been indicated, except in the case of riboflavin. After a review of the literature, however, the National Research Council stated that the research results on riboflavin do not appear to warrant increases in the current recommendations (Whitmire,

1991). Additional research in this area is needed.

Two other vitamins in the B-complex group, B-6 and B-12, have been utilized as supplements due to speculation on their roles in human nutrition and exercise. Theoretically, Vitamin B-6 may promote aerobic endurance, however, research with controlled studies, has not shown B-6 to enhance performance (Whitmire, 1991).

Injections of Vitamin B-12 are often used by athletes in a belief that oxygen delivery will be increased and endurance capacity enhanced. Although widespread use of B-12 appears to be common, research studies assessing B-12 supplementation and physical performance have not been conclusive (Whitmire, 1991).

Vitamin C supplementation is popular with athletes. The role of Vitamin C in the synthesis of collagen, epinephrine, and anti-inflammatory corticoids of the adrenal gland, as an antioxidant, and in the promotion of iron absorption has led many to believe that the vitamin is implicated in exercise and stressful situations (Whitmire, 1991). However, the expectation that high doses of Vitamin C will improve physical performance appears to be unfounded (Whitmire, 1991).

Fat-Soluble Vitamins. The fat-soluble vitamins include Vitamins A, D, E, and K. Of the fat-soluble vitamins, Vitamin E may be the most abused by athletes. Athletes frequently consume wheat germ oil and supplemental Vitamin E in the hopes of improving endurance capabilities. Studies

on Vitamin E have shown that deficiencies in animals result in abnormal muscle function. However, Vitamin E deficiency is uncommon in humans due to the widespread availability of this vitamin in foods, particularly vegetable oils (Marcus, 1986).

Minerals in Exercise

Minerals play essential roles in human metabolism as cofactors in enzyme systems involved in energy production or in other important roles related to work. The electrolytes, several trace minerals, and the major mineral calcium are of particularly interest to many athletes.

Athletes have shown less concern for mineral status, possibly because fewer ergogenic qualities have been ascribed to them (Wilmore and Costill, 1992). Of the minerals, iron and calcium have been most frequently investigated in athletes.

Iron. Physiological function and physical performance can be influenced by iron status. It is a well accepted fact that iron-deficiency anemia impairs oxygen transport and, thereby, aerobic power and performance capacity. Studies of athletes have shown low biochemical measures of iron in numerous individuals (Balaban, Cox, Snell, Vaughn, Frenkel, 1989).

Mechanisms proposed for iron deficiency include inadequate dietary iron intake, inadequate iron absorption, losses in sweat, gastrointestinal blood loss, and red blood

cell hemolysis with hematuria (Buskirk, 1990). Sports anemia is frequently cited in the literature as a problem with athletes, however, other authorities state that no true sports anemia exists (Hultman, Thomson, and Harris, 1988).

Hultman, et al, (1988, p. 1016) view sports anemia as "an altered iron metabolism, emphasizing liver hepatocytes as an adaptation strategy to large blood volumes". The research implications here indicate that the athletes are not iron deficient when all markers of iron status are considered.

However, continued evidence of iron deficiency in athletes creates a need for awareness. Dietary recommendations should emphasize a diet rich in iron as well as Vitamin C, which enhances iron absorption (Hultman, Thomson, and Harris, 1988).

Calcium. Calcium levels in athletes are of concern due to stress on bones during exercise. The occurrence of stress fractures, and decreases in vertical bone density, particularly in amenhorreic women athletes, are examples of problems. In a study of the relationship of diet, exercise, and amenorrhea with bone mineral status in trained young women, bone mineral density of the lumbar spine was significantly lower in amenorrheic women (Nelson, Fisher, Catsos, Meredith, Turksoy, and Evans, 1986).

It has been suggested that an increase in calcium intake may be of some benefit in preventing or slowing bone loss in amenorrheic women. Because less calcium is absorbed

and retained when estrogen levels are low, calcium intake in amenorrheic athletes may need to be increased (Drinkwater, 1992). A blanket prescription for calcium intake in athletes is not available as further research is needed on women as well as men. However, the intervention of a dietitian in the evaluation and treament of amenorrheic women is advised (Nelson, Fisher, Catsos, Meredith, Turksoy, and Evans, 1986).

Water

Water is an essential nutrient and is crucial to success in athletics. The amount of heat produced during exercise is enough to raise core body temperatures by one degree Celsius every five to eight minutes. Without an effective method of dissipating the heat, moderate-intensity exercise could raise body temperatures to lethal levels in fifteen to thirty minutes (Lyle and Forgac, 1991). Therefore, ensuring adequate fluid intake is a key element in athletic performance.

Because of the need for fluid and the fact that replacement of electrolytes lost during perspiration may be a problem, sports drinks have been developed. Sodium, chloride, and small amounts of potassium are found in perspiration. However, perspiration is hypotonic to the body fluids, so the actual concentration in the blood rises during exercise, negating the need for replacement during or after exercise (Williams, 1989). Certain sports drinks contain carbohydrate for carbohydrate replacement and additional

energy during exercise. Carbohydrate is not needed unless exercise is continuous for longer than one hour. An advantage of sports drinks is that it will provide fluid for the athlete if no water is consumed. In most situations, water or diluted fruit juice will provide the necessary nutrients.

Studies show that electrolyte replacement is seldom necessary in the trained athlete, however, in endurance athletes, carbohydrate replenishment may be needed. Running for two or more hours may result in the need for such a dietary supplement (Thornton, 1989).

Studies of long-distance cyclists have shown that sports drinks can delay the onset of fatigue (Thornton, 1989). The increased interest in sports drinks combines this aspect of the beverages with the escalating popularity of triathalons in marketing techniques utilized by the manufacturers.

Ultramarathon runners in a 100 mile race over rugged terrain were studied in an attempt to determine and maintain normal fluid and electrolyte levels. Each runner was weighed at the beginning of the race and then again after every 10 miles. Total fluid consumption was measured for each 10 mile interval, and the subsesquent fluid requirements were estimated for the next 10 miles. Deficits of the preceding 10 miles were added to the fluid mixture containing electrolytes which was to be consumed. Results showed that it was possible to maintain a normal fluid and electrolyte status during prolonged physical exercise over extreme-

ly adverse conditions (Newmark, Toppo, and Adams, 1991).

Translating Nutrient Needs Into Foods

Reports of nutrition education needs for athletes frequently include choosing foods to meet nutrient needs. A survey of female runners on nutrition and menstrual patterns illustrated the need for obtaining nutrients from wholesome foods (Clark, Nelson, and Evans, 1988). The application of food sources of nutrients can be accomplished through meal planning. Meal planning guides include the Dietary Guidelines, the Basic Four Food Groups, and the Exchange System.

The Dietary Guidelines are the federal government's advice about diets of healthy Americans age two years and over. The Guidelines are broad statements which recommend eating to promote good health and prevent chronic disease.

Using the Basic Four Food Groups has been shown to provide a nutritionally adequate diet in dietary intake studies (Kant, Schatzkin, Block, Ziegler, and Nestle, 1991). The food group system has also been reported as an efficient method of computerized dietary analysis.

The Exchange System, originally developed for use with diabetic patients, provides more detail than the Dietary Guidelines or the Basic Four Food Groups. It provides information on six food groups, with specific amounts for protein, carbohydrate, fat, and calories for each group. The Exchange System is a more complete system.

These three sets of meal planning guidelines have been used successfully for many years. However, current re-

searchers are seeking to develop an instrument for use by athletes in monitoring intake. Moses and Manore (1991) have developed a carbohydrate monitoring tool for use with athletes, based on the assumption that carbohydrate is the cornerstone of the competitive diet. The carbohydrate monitoring tool as well as the Exchange System require education for optimum use. Daily meal planning is essential, however, in athletes the importance of the diet as related to competition must be maximized.

Pre-Post-During Competition Eating

An adequate diet before, during, and after competition will aid hydration, increase suboptimal muscle and liver glycogen stores, and maintain blood glucose levels during prolonged exercise (Coleman, 1991). The optimum dietary recommendations suggest that the majority of energy come from carbohydrates. In most situations, total energy intake must be raised to meet the increased energy expended during training and competition.

Research is frequently conducted on cyclists in this area because of the demands of the sport. Cyclists consuming 1.1 to 2.2 grams of carbohydrate per kilogram of body mass one hour before cycling exercise and time-trial performance significantly improved their exercise capacity (Sherman, Peden, and Wright, 1991). Subjects consumed liquid carbohydrate as either a 1.1 gram (low carbohydrate), 2.2 gram (high carbohydrate) per kilogram of body mass, or a placebo prior to cycling at 70% of maximal oxygen consump-

tion for 90 minutes and then undergoing a performance trial.

In athletic events of high intensity and long duration, performance is usually limited by carbohydrate availability (Costill, 1991). A high carbohydrate diet before exercise enables storage of nutrients thereby improving performance. Liquid meals are high in carbohydrate and palatable, they contribute fluid as well as carbohydrate, therefore, they satisfy many of the requirements for athletes' meals. An additional advantage is that liquid meals can be consumed closer to competition time because of their shorter gastric emptying time. A low stool residue is produced, therefore, immediate weight gain is minimal (Coleman, 1991).

Five goals in planning the pre-event diet should include adequate energy intake to prevent hunger. Second, the dietary plan should allow the stomach and upper bowel to be empty at the time of competition. Third, food and fluid should guarantee optimal hydration. Fourth, foods should minimize gastrointestinal distress. Lastly, the diet should include familiar foods for the individual, especially if one is convinced that it will make him win (Smith, 1976).

During competition, carbohydrate feeding may be needed to provide energy. However, the exercise must be continuous for more than 90 minutes for this to occur. Carbohydrate feedings during exercise appear to delay fatigue by as much as 30 to 60 minutes by allowing the muscles to utilize blood glucose. After two to three hours of exercise without carbohydrate feeding, blood glucose concentration declines

(Coyle, 1988). Fatigue may result due to the lack of glycogen as well as blood glucose. Most athletes report experiencing local muscular fatigue in this situation (Coyle, 1988). Coyle recommends carbohydrate feeding of about 35 grams every 30 minutes during prolonged strenuous exercise in order to delay fatigue.

After exercise, the diet should contain sufficient carbohydrate to replenish the glycogen stores. For activity lasting more than 90 minutes, replenishment of the energy supply during the activity may be necessary. An average of five percent of the muscle glycogen used during exercise is resynthesized each hour following exercise (Coyle, 1988). Therefore, at least 20 hours are required for complete restoration after exhaustive exercise. During successive days of competition or intense training, athletes need approximately 100 grams of carbohydrate within 15-30 minutes after exercise followed by an additional 100 grams every two to four hours thereafter (Coyle, 1988). Thirst is prevalent, rather than hunger, after competition, therefore, carbohydrate beverages may be preferred.

Training and competition change the nutrient needs of the athlete, therefore, the meal plan is essential. Individualized meal plans should be based on nutritional assessment consisting of: anthropometric measurements, biochemical measures, physical examination, and diet history (Grant and DeHoog, 1991). Registered dietitians are well-equipped for this task. Nutritional assessment can be used to optimize the individual athlete's performance and long-term good

health (Slavin, 1991). The assessment may reveal inadequacies due to disease or improper nutrient intake. The need for nutritional assessment varies with individuals, however, Slavin (1991) recommends a one-time baseline nutritional assessment for all athletes, with yearly reassessments for elite athletes. Such an assessment is helpful in planning meals, for nutritional intervention, or for recommending supplements.

Supplements

"The individuals most likely to supplement their diets are the ones least likely to need supplements" (Clark, Nelson, Evans, 1988, p. 127). Supplement use and abuse among athletes due to myths and misconceptions about nutrient needs during exercise is widely reported. Of 115 elite female runners responding to a nutrition and menstrual patterns questionnaire, 71% regularly took supplements; of those rating their diet as excellent, 74% took supplements; of the runners rating their diets as good, 76% took dietary supplements according to researchers, Clark, Nelson, and Evans (1988).

Protein and amino acid supplements, particularly large quantities of isolated amino acids, are frequently consumed by athletes. Large doses have been associated with fluid imbalance, excessive calorie intake, and increased urinary calcium excretion (Slavin, 1991). Long term research has not been conducted on these supplements, therefore, they are

not recommended.

Certain nutrient supplements, such as the B-complex vitamins, have been shown to aid the athlete, (Williams, 1991), however, those nutrients can easily be obtained through proper dietary sources. Nutritional supplements are encouraged by many users and sellers of a variety of ergogenic aids.

Ergogenics are expected to elevate or improve the performance of the individual above that expected (Wilmore, 1992). Most ergogenic aids have been designed to enhance the application of specific forms of energy (Williams, 1989). Ergogenics are categorized into five areas: mechanical or biomechanical aids, pharmacological aids, physiological aids, psychological aids, and nutritional aids. Certain nutritional ergogenic aids may provide some benefits under certain conditions. However, those nutritional ergogenics aids that have been shown to improve performance may be provided in adequate amounts through proper dietary selection (Williams, 1989).

Vitamin-like substances have also been suggested to improve athletic performance. One such substance, marketed under the name Vitamin B-15 actually has no definite chemical identity (Williams, 1989). Another common aid is a mixture of calcium gluconate and dimethylglycine, an amino acid. Bee pollen, a mixture of organic compounds and a mixture of vitamins, has also been marketed specifically for athletes, however, studies reveal no beneficial effects upon performance.

Weight Control

Along with ergogenic aids, magical answers to weight control abound among sports active individuals. Athletes exist in a highly competitive culture in which the manipulation of eating and weight is thought to be essential for both performance and appearance (Brownell, Rodin, Wilmore, 1992). Recommendations are made for ideal percentage body fat for athletes involved in various sports (Wilmore and Costill, 1992). However, such values should not be viewed as the ideal percentage body fat for an individual athlete. A range of fatness should be recommended that is realistic and appropriate for the individual.

Different sports do require different body types, with varying amounts of fat required. Football players may need the cushioning effects of fat, whereas wrestlers frequently attempt to lose fat and water for lower weight. There appears to be a natural selection process whereby body type may dictate success in certain sports (Thornton, 1990). Therefore, the individualization of weight is extremely important, with assessment of need and current body composition considered.

Weight demands appear to place athletes at risk for eating disorders due to nutritional or weight demands of sport. Certain athletes might be at a greater risk than

others because of particular psychological or biological characteristics (Brownell and Steen, 1992). One example is seen in the case of a 28-year-old female marathon and fitness runner with leg swelling, fatigue, and loss of endurance (Roberts and Elliott, 1991). She was running at least one hour per day as well as swimming and biking, for a total of 3 hours of exercise per day. Her first reports of dietary intake were normal, however, later she admitted food avoidance. Her height was 5'6" and weight 90 pounds (70% of her desirable body weight) with physical examination revealing a malnourished looking woman. Although the young woman received counseling, she continued to lose weight and to exercise beyond a healthy level.

Borgen and Corbin (1987) report that sports participation may actually contribute to the development of these disorders due to pressure to achieve or maintain established weights set for competition. Treatment requires nutritional as well as psychiatric intervention, using the team approach. "Preserving the health of the athlete must be the ultimate goal" (Pomeroy and Mitchell, 1992, p. 219). Concern for the individual is essential.

The opposite scenario, weight gain, is a concern for many athletes in trying to add muscle and lean body mass. Results of a nutrition intervention program with 44 high school football players resulted in an average gain of 6.3 pounds in eight weeks as compared to 2.1 pounds in the control group. The program involved professional dietary

counseling, a high-calorie sport shake and a practical method for keeping track of consumed foods. Weight-training contributed to a significant increase in lean body mass and upper body strength (Niemuth, Lane-Larsen, Meisterling, Wadsworth, Cummings, Holtmeier, 1991). The authors recommend professional supervision so that dietary habits become habit and the desire for unsafe methods of weight gain is avoided.

Locating Nutrition Information

In order to aid the individual in translating nutrient needs into foods, several methods of locating nutrition information may be necessary. Barr (1987) reported sources of information used by athletes as 69% magazines, 54% friends/teammates, 53% high school courses, and 30% coaches.

One method of obtaining accurate information is through label reading. Confusing and misleading claims on labels have led the Food and Drug Administration to launch a major initiative to make needed changes (Food Labeling; Advance Notice of Proposed Rulemaking, 1989). As Americans are more health conscious than ever, increased scientific evidence about the effects of diet on health has prompted consumers to seek information about foods consumed. However, labels do not always provide a clear cut answer.

Two goals of the FDA also apply to sports nutrition. The label must be understandable, reporting health concerns, and confusion eliminated. Educators must be involved in the dissemination of the new labeling information. Storlie

(1989) recommends that nutrition educators work through existing communication channels and create new ones.

A second method of locating information is through accurate, professional sources of nutrition information. The dissemination of information should be done by professionals. Graduates of reputable institutions in the area of nutrition, or individuals holding the RD credential provided by the American Dietetic Association are qualified professionals. Literature provided should be based on scientific research. The following research journals are recommended: Medicine and Science in Sports and Exercise, Journal of Applied Physiology, Journal of the American Dietetic Association, and The Physician and Sportsmedicine (Storlie, 1989). Additionally, The American Journal of Clinical Nutrition provides in-depth articles on nutrition which may be applied to exercise.

The Sports and Cardiovascular Nutrition (SCAN) practice group of the American Dietetic Association conducts a symposium that focuses on sports nutrition triennially. Their newsletter, The Pulse, provides up-to-date recommendations and current research. Also, the American College of Sports Medicine dedicates sessions devoted to sports nutrition at its annual meetings.

The number of sports nutrition practitioners is increasing, however, few colleges and universities have established curricula to train such professionals (Storlie, 1989). Developing the curricula is a need for the future in

providing a better means for communicating information.

Sports nutrition information has been plagued with discrepancies between the state of the art and current practice (Grandjean, 1989a). Nutrition educators need to be more effective in getting the correct message to athletes. Information must be presented in an understandable manner, utilizing learning activities which enable the athlete to internalize the knowledge.

Learning Activities in Sports Nutrition

Decisions about learning activities and class format are based upon several criteria. Included are appropriateness for the situation and the learner, variety in order to account for various learning styles, activity within available time frames, and sufficient resources. Lecture is the most frequently used method of class delivery, however, it is often the most abused. Instructional procedures that implement the social context and interpersonal interaction factors important to the goals of nutrition education are hands-on activities, cooperative learning as in group discussion, and inquiry learning, as in research (Johnson and Johnson, 1985). As is indicated in the review of literature on nutrient needs, research-based information should be used. Actual participation in research projects, therefore, may be appropriate.

Using methods of dietary analysis enables the learner to view personal intake in an objective manner (Skinner, 1991). Therefore, the use of food frequency questionnaires,

food intake diaries, and computerized dietary analysis may assist. Dietary deficiencies listed on a computer printout may often encourage the malnourished athlete to improve intakes of protein, iron, and zinc (Clark, Nelson, and Evans, 1988). Basing the information on case studies may also be a realistic method of teaching sports nutrition.

Actual food preparation techniques and use of the Exchange System as a planning tool may be recommended if time and resources allow. Food preparation requires time and funding. The Exchange System is a tool requiring adequate time for internalization. Label reading and menu application of these skills in daily life, however, is an essential component of nutrition education. Athletes must be able to apply the information to their daily intakes.

Conclusion

In summary, a curriculum in sports nutrition may be beneficial in home economics. Academic preparation should focus on the concepts included in the principles of normal nutrition with emphasis on variations in nutrient needs due to exercise. Information based on scientific investigation rather than myth should be the basis of the curriculum. Learning activities should revolve around the concepts, using methods which foster learning at higher levels of thinking.

CHAPTER III

RESEARCH PROCEDURES

Descriptive research was employed in the sports nutrition curriculum study, utilizing a questionnaire as the survey method of collecting information. Participants provided information on the appropriate concepts and learning activities in sports nutrition.

The survey method was selected because it describes phenomena or determines what is typical about phenomena (Joseph and Joseph, 1986). It is undertaken for the purpose of understanding the total population studied by forming generalizations based on the data from the sample. An advantage of survey research is using a large sample to obtain detailed information in answering research questions.

The survey instrument designed for the project, Sports Nutrition Curriculum Survey (Appendix A), was a questionnaire on appropriate topics in sports nutrition. Because sports nutrition is of interest in dietetics programs, curriculum placement was also investigated. Learning activities designated as helpful in teaching sports nutrition were included.

A search for a suitable instrument was inconclusive; therefore, the instrument was developed for the project.

The instrument utilized topics appearing in current published research. The questionnaire was approved by the Institutional Review Board of Oklahoma State University. A pilot study was conducted in order to validate the questionnaire.

Pilot Study

The instrument was validated for content validity through a pilot study of five faculty members at Oklahoma State University and five SCAN members in different parts of the United States. The participants in the pilot study included Registered Dietitians involved in extension, university teaching, clinical, and consultant positions.

Each member was mailed a draft of the questionnaire with an evaluation instrument requesting information on clarity and validity. Responses were used in revision of the instrument.

Population and Sample

The population studied was the Sports and Cardiovascular Nutrition practice group of the American Dietetic Association (SCAN). Membership in SCAN is approximately 3,700. The sample was randomly selected from the membership directory. A national survey was done in order to obtain information from as many different types of SCAN members as possible. For the random sample, 361 questionnaires were mailed, accompanied by an introductory letter (Appendix A). Instructions for return of the questionnaire included fold-

ing and sealing, with the return postage provided.

The survey was done in the fall of 1991, with the return date set at November 25. The initial mailing resulted in 134 responses. Eleven questionnaires were returned due to improper address, illustrating a problem with the frame.

A second mailing of the instrument resulted in 25 additional responses. Follow-up phone calls were made to ten additional non-respondents. Due to the variety of reasons for non-response, the researcher determined that the non-respondents were not uniformly different from the respondents. Forty-two phone calls were made before reaching the ten non-respondents. Results of the ten phone calls were included in the final response total.

After the two mailings and phone calls, 45 of the 50 states were represented in the survey. A third mailing was sent to residents of the five states (Alaska, Hawaii, Montana, New Mexico, and Oklahoma) not represented in hopes to secure information from all parts of the United States. The third mailing resulted in responses from an additional four states, therefore, 49 of the 50 states were represented. No response was received from Alaska. The three mailings and phone calls resulted in a 48% response rate.

Data Collection

The questionnaires were returned by mail. Each of the questionnaires were numbered with a code number. Data was stored utilizing PC File III, a data base manager program.

Data Analysis

The data were analyzed using the SAS system. The first step in data analysis was to summarize the data using descriptive statistics. Descriptive statistics from a sample permit the description of many scores with a small number of indices (Kiess, 1989).

Frequency tables were developed for each of the seventy-two variables of the questionnaire. The calculations included variables in all sections: Personal Information, Sports Nutrition in the Curriculum, and Teaching Sports Nutrition (Appendix A).

The learning activities, item 20 of the questionnaire (Appendix A), were analyzed according to the responses, with mean scores calculated for each activity. The activities were then ranked according to mean scores. The learning activities were also compared using a paired t-test. All possible pairs were considered in order to determine if significant differences existed in the respondents' perceptions of the activities' levels of importance. Such a t-test permits determination of the probability that an observed difference between sample means would occur if sampling error alone were responsible for the obtained difference (Kiess, 1989).

The curriculum topics, item 21 on the questionnaire (Appendix A), were summarized and a score assigned to each topic based on the number of times chosen in the top five topics. The topics were then listed according to rank.

A chi-square test was used in order to determine if there were significant differences in mean preference scores for the individual topics, with respect to education level, recency of education, and dietetic practice area. Chi Square is a nonparametric test which provides an effective way to determine if the observed frequencies are significantly different from the expected frequencies (Kiess, 1989).

Methodological Assumptions

It was assumed that the responses of the survey participants represent their understanding of the instrument. Lack of communication may create a problem in survey research (Touliatos and Compton, 1988).

It was also assumed that the topics identified as appropriate for sports nutrition identified through a review of literature are representative of those appropriate for such a curriculum. Current research is normally a sound source for provision of curriculum topics.

Limitations

Limitations are common to most surveys. The quality of the information and the validity of findings depend on the accuracy and truthfulness of self-reported data (Touliatos and Compton, 1988). Because of the nature of the mailed questionnaire, one limitation was due to accuracy of the responses.

A second limitation includes a potential bias due to a low response rate. The fact that additional information could not be obtained from the respondents after responding to the questionnaire presents a third limitation, there may have been some misinterpretation of questions.

Summary

The curriculum study in sports nutrition utilized a mailed questionnaire, the Sports Nutrition Curriculum Survey. The sample was randomly drawn from the target population, members of the dietetic practice group SCAN of the American Dietetic Association. The purpose of the study was to identify appropriate curriculum topics in sports nutrition.

Responses were analyzed using the SAS system, with descriptive and inferential statistics utilized. Frequency tables were developed for each of the variables, enabling the researcher to describe the respondents as well as their responses. For the learning activities, a ranking was performed and paired t-tests were used in determining differences in the respondents' perceptions of level of importance of those activities. The curriculum topics were ranked and a chi square test was used in determining the differences in mean preference scores for the individual topics with respect to education levels, recency of education, and practice area. The responses may be used in designing a sports nutrition curriculum, with suggestions made for prerequisites, placement in curriculum, and learning activities.

CHAPTER IV

FINDINGS

The development of a concept-based sports nutrition curriculum was the goal of the project. The instrument, Sports Nutrition Curriculum Survey, was developed and used as a mailed questionnaire. The population sampled consisted of members of the Sports and Cardiovascular Nutrition (SCAN) practice group of the American Dietetic Association.

Objectives of the research included identifying appropriate topics and learning activities for sports nutrition and developing recommendations for a course in sports nutrition. Recommendations were considered with respect to level of education, recency of education, and practice area.

The Sports Nutrition Curriculum Survey resulted in 173 responses to the 361 surveys mailed, a 48% response rate. Registered dietitians made up 97.7% of the respondents, with 97.7% listing gender as female. The highest level of education reported by 60% of the respondents was a master's degree, with 34% holding a bachelor's degree, 0.6% holding a specialist degree, 4.1% a doctorate, and 1.2% in the other category (see Figure 1, page 47).

With respect to recency of education, 3.6% reported completion of education less than one year prior to answering the questionnaire. Respondents reporting 1-5 years

since completion of education equaled 30.8%. Completion of education 6-10 years previously was reported by 34.9%. Reports of completion of education 11-15 years previously accounted for 17.2% of the respondents and only 13.6% reported over 15 years.

Respondents reporting years of work experience in dietetics included 0.6% as less than one year, 22.4% as 1-5 years, and 30.6% as 5-10 years. The more experienced respondents included 22.4% reporting 11-15 years and 24.1% reporting over 15%.

The dietetic practice area most frequently reported was clinical dietetics with 31.4%, consultant/private practice accounted for 21.9%, 14.8% community dietetics, and 12.4% fitness/wellness. Only 9.5% were in the education/research category and 7.7% in management. Other responses included 0.6% in communication, 0.6% in sales, and 1.2% as unemployed.

Sports Nutrition in the Curriculum

Reports of taking a sports nutrition course was indicated by only 43% of the respondents, with 57% reporting a deficiency in this area. Of those taking such a course, 49.3% were in a post-graduate workshop, 41.1% a graduate class, and 9.6% an undergraduate course. A smaller percentage reported teaching sports nutrition, with only 35.5% responding positively. The level of those courses taught were 60.3% as undergraduate courses, 15.5% as post-graduate workshops, and 12.1% as graduate courses. Other types of

classes reported included 3.4% to a television audience, 3.4% to fitness center members, 3.4% to the lay public, and 1.7% to professional football players.

When asked if a sports nutrition course is a potentially valuable addition to the dietetics curriculum, 97.5% replied positively. However, only 55.5% felt that sports nutrition should be a requirement for dietetics majors. In consideration of sports nutrition as a course for dietetics majors, 46% preferred it as an undergraduate course elective, with 32.7% as an undergraduate course requirement, 15.9% as a graduate course, and 5.3% as a workshop.

In consideration of sports nutrition as an elective for non-majors, 88.5% responded positively. The level of preference for non-majors was 79.7% as an undergraduate course, 11.9% as a workshop, and 8.4% as a graduate course. The requirement of an introductory course in human nutrition as a prerequisite for a sports nutrition course resulted in 84.2% responding positively.

The level of a course is important in curriculum planning. Therefore, a chi-square test was performed to determine difference in preferences with respect to dietetic practice area of the respondents. Curriculum placement is of interest to educators; however, dietitians in other practice areas may not agree. Information on undergraduate, graduate, or workshop levels were requested from respondents. The results were not significant; however, due to the

small number of educators in the sample, caution is urged in accepting this finding (see Table I).

TABLE I

CHI SQUARE FOR CURRICULUM PLACEMENT ACCORDING TO DIETETIC PRACTICE AREA

Topic	n	df	Value	Probability
Majors Level	111	6	3.392	0.758
Non-Majors Level	138	4	9.066	0.059

Teaching Sports Nutrition

When asked if interested in teaching a sports nutrition course or workshop, 59.9% replied yes, 40.1% replied no. Inquiry regarding class format most appropriate for a sports nutrition course resulted in 143 recommending lecture, 128 preferring group discussion, 134 selecting hands-on activities, and 56 selecting research participation.

Appropriate titles for a course in sports nutrition resulted in a variety of answers. However, 51.4% chose sports nutrition. The other suggestions of the five most frequently selected titles were 9.3% nutrition and sport, 8.4% nutrition and the athlete, 7.5% nutrition and physical performance, and 6.5% nutrition and fitness. One respondent reported that the title should not indicate that the course

was for elite athletes only, yet emphasize that nutrition in exercise was the important element.

Learning Activities

Respondents were asked to rate the importance of selected learning activities in a sports nutrition course for non-majors on a scale from 1 (no importance) to 5 (essential). Ten activities were included, with space provided for suggestions by the respondent. Those activities included food intake diaries, food frequency questionnaires, computer-assisted dietary analysis, food preparation techniques, use of the Exchange System, individual case studies, review of current sports and research projects.

Ranking of Learning Activities

The activities were ranked with respect to the average rating per respondent; that is, add all ratings for an individual activity and divide by the number of respondents who provided a rating (see Table II, page 53). Based on this criterion, the most importance was given to the review of current sports nutrition research. Label reading, food intake diaries, menu selection, and computer-assisted dietary analysis followed in that order, to complete the top five activities. The next five activities were ranked as follows: case studies, food frequency questionnaires, food preparation techniques, research projects and the Exchange System.

TABLE II

RANK ORDER OF LEARNING ACTIVITIES AS RECOMMENDED BY SCAN MEMBERS, PAIRED-T TEST INDICATES DIFFERENCES

Activity	n	Sum	Mean	Grouping*
Research Review	160	711	4.44	a
Label Reading	161	670	4.16	b
Intake Diary	160	638	3.99	bc
Menu Selection	161	623	3.87	cd
Dietary Analysis	161	608	3.78	d
Case Studies	160	602	3.76	d
Frequency Questionnaire	158	530	3.35	e
Food Preparation Techniques	160	518	3.24	ef
Research Projects	158	493	3.12	f
Exchange System	160	442	2.76	g

*Two activities followed by the same letter are not significantly different from each other.

Other activities suggested by the respondents included experience with athletes, such as discussions of current practices, developing personalized plans for individual sports, exercise diaries, reviewing sports nutrition education sets, and assessing coaches' intake as compared team intake. These examples conveyed interesting and creative approaches to teaching sports nutrition (see Appendix B).

Comparison of Learning Activities

A second procedure, the paired t-test, was calculated for all possible pairs in the learning activities. The results were significant in the majority of the comparisons, indicating that the respondents perceived those activity

levels as being different with respect to importance (see Table II, page 53).

Five Topics in Sports Nutrition

The list of curriculum topics presented to the respondents was determined through a review of literature. Each respondent was asked to identify and rank the five essential topics to be included. These choices were scored as 5 points for a top choice, 4 points for a second choice, down to 1 point for a fifth choice and 0 points if the topic was not included. The top five topics chosen by the respondents (highest point totals) were as follows: 1) fluids and fluid replacement, 2) carbohydrate needs, 3) principles of normal nutrition, 4) pre-post-during competition eating, and 5) the biochemical aspects of metabolism. The second five selected included translating nutrient needs into food, protein needs, accurate sources of nutrition information, nutrition needs during exercise, and weight control. As illustrated in Table III, the most importance was given to fluid and hydration and carbohydrate needs. A wide variation exists in totaled scores, in fact, the scores for the first two topics more than triple the scores for the last six topics.

TABLE III

RANKING OF SPORTS NUTRITION TOPICS AS RECOMMENDED BY SCAN MEMBERS

Topic	Total Points
Fluid and Hydration	280
Carbohydrate Needs	270
Principles of Normal Nutrition	146
Pre-Post-During Competition Eating	121
Biochemical Aspects of Metabolism	86
Translating Nutrient Needs into Food	76
Protein Needs	70
Accurate Sources of Information	56
Nutrient During Needs During Exercise	56
Weight Control	40

Examination of Hypotheses

Three hypotheses were examined in order to identify differences in the importance of topic identification with respect to the demographic variables, level of education, recency of education, and dietetic practice area of respondents. Chi-square tests were used to compare responses.

Level of Education

H1: There will be no significant difference between the importance of the topics identified for a sports nutrition curriculum as associated with the level of education of the respondents. Comparison of the identification of the topics with respect to level of education resulted in a significant difference between groups who placed "translat-

ing nutrients into foods" in the top five. The bachelor's level group was different from the proportion who did so in the master's level group. No other items resulted in significant differences between the groups: therefore, the null hypothesis is not rejected for any of these items. Table IV illustrates the chi-square values for each of the topics with respect to education level.

TABLE IV

CHI SQUARE COMPARISON OF THE LEVEL OF EDUCATION OF 160 RESPONDENTS WITH THE SELECTED TOPICS

Topic	df	Value	Probability
Fluid	1	0.132	0.716
Carbohydrate	1	0.383	0.536
Normal Nutrition	1	0.670	0.413
Pre-Post-During	1	2.494	0.114
Metabolism	1	0.386	0.534
Translating Needs	1	7.085	0.008*
Protein	1	0.025	0.874
Accurate Sources	1	0.002	0.965
Nutrient Needs	1	0.386	0.534
Weight Control	1	0.015	0.901

*significant at <.05

Recency of Education

H2: There will be no significant differences between the level of importance of the topics identified for a sports nutrition curriculum as associated with the recency

of education of the respondents. Chi-square was the analysis utilized, resulting in no significant differences in topic selection with respect to recency of education of the respondents (see Table V). Therefore, the null hypothesis is not rejected for any topic. Each of the top ten topics identified were compared to the respondents recency of education. The lack of differences indicated that the SCAN members agree.

TABLE V

CHI SQUARE COMPARISON OF THE RECENCY OF EDUCATION OF 173 RESPONDENTS WITH THE SELECTED TOPICS

Topic	df	Value	Probability
Fluid	4	0.133	0.998
Carbohydrate	4	4.115	0.391
Normal Nutrition	4	8.218	0.084
Pre-Post-During	4	3.118	0.538
Metabolism	4	2.697	0.610
Translating Needs	4	6.226	0.183
Protein	4	3.156	0.532
Accurate Sources	4	0.402	0.982
Nutrient Needs	4	5.293	0.259
Weight Control	4	1.764	0.779

Dietetic Practice Area

H3: There will be no significant difference between the levels of importance of the topics identified for a sports

nutrition curriculum as associated with the current employment of the respondents. The analysis used was chi-square. No significant differences were found. Therefore, the null hypothesis is not rejected for any topic. Regardless of dietetic practice area, the SCAN members reported similar opinions in terms of important topics in sports nutrition (see Table VI).

These findings appear to confirm the identification of the important topics in sports nutrition. The specific topics given the most importance were fluid and carbohydrates, with the general topics, principles of normal nutrition and metabolism, and pre-post-during competition eating included.

TABLE VI

CHI SQUARE COMPARISON OF THE DIETETIC PRACTICE AREA OF 165 RESPONDENTS WITH SELECTED TOPICS

Topic	df	Value	Probability
Fluid	5	4.823	0.438
Carbohydrates	5	1.804	0.875
Normal Nutrition	5	3.222	0.666
Pre-Post-During	5	5.262	0.385
Metabolism	5	5.390	0.370
Translating Needs	5	9.058	0.107
Protein	5	2.178	0.824
Accurate Sources	5	6.743	0.241
Nutrient Needs	5	5.791	0.327
Weight Control	5	0.976	0.964

Summary

In summary, the respondents to the Sports Nutrition Curriculum Survey agreed upon the five most important topics in sports nutrition, regardless of education level, recency of education, or dietetic practice area. The analyses affirmed the hypotheses, therefore, they were not rejected.

The learning activities ranked by the respondents placed an emphasis on research review as well as practical application. The statistical tests affirmed the respondents' perceptions of differences with respect to importance.

CHAPTER V

FINDINGS, CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS

The Sports Nutrition Curriculum Survey requested information from members of the American Dietetic Association who are members of the dietetic practice group, Sports and Cardiovascular Nutrition (SCAN). The purpose of the study was to identify appropriate topics and learning activities for a sports nutrition curriculum and to assess the importance of the topics as perceived by the respondents. The respondents were asked to rate learning activities and topics in sports nutrition for use in curricula. The topics were ranked by the respondents and differences were measured with respect to education level, recency of education, and employment. Information was also requested on placement in the curriculum and prerequisites needed for sports nutrition.

Findings

The three null hypotheses tested and findings related to them follow. H1: There will be no significant difference between the importance of the topics identified for a sports nutrition curriculum as associated with the level of education of the respondents. The researcher found that the hypothesis could not be rejected since no significant dif-

ferences existed between levels of importance of the topics and education levels of the respondents. The levels of education represented in the study included bachelor's, master's, specialist's, and doctorate degrees. As stated by Tyler (1950), outlining curriculum with suggestions from subject matter specialists can result in valuable contributions regardless of specialization. Apparently, the respondents agreed upon the importance of topics regardless of their level of education.

H2: There will be no significant differences between the levels of importance of the topics identified for a sports nutrition curriculum as associated with the recency of education of the respondents. There were no significant differences between levels of importance of the topics when compared to recency of education of the respondents, therefore, the hypothesis is not rejected. Oliva (1988) refers to the experienced and skilled professionals as those frequently establishing themselves as specialists in an area, however, the newly educated did not disagree with the more experienced in this study.

H3: There will be no significant difference between the levels of importance of the topics identified for a sports nutrition curriculum as associated with the current employment of the respondents. No significant differences existed between the perceived levels of importance of the topics and the practice area of respondents, therefore, the hypothesis was not rejected. Tyler (1950) cites suggestions from subject matter specialists as defin-

ing particular contributions that a subject can make to large educational functions. This study supports that statement as subject matter specialists from various practice areas agreed on the importance of topics in sports nutrition.

The most important topics in the sports nutrition curriculum, as identified by the respondents follow. The topic ranked highest was fluid and hydration state. The second was carbohydrate needs; third, the principles of normal nutrition; fourth, pre-post-during competition eating; and fifth, the biochemical aspects of metabolism. The second five topics included translating nutrient needs into food, protein needs, accurate sources of nutrition information, nutrient needs during exercise, and weight control.

With respect to identifying appropriate learning experiences in sports nutrition, SCAN members ranked research review as the most important method, followed by label reading, intake diary, menu selection, dietary analysis, case studies, food frequency questionnaire, food preparation techniques, research projects, and the Exchange System. Other activities suggested by the respondents are listed in Appendix B. Suggestions focused on requiring experience with practicing athletes, such as observing and recording dietary intake as well as exercise habits. The basic requirement of learning activities is that they enable the student to derive satisfaction from the experience, allowing exploration in the area (Tyler, 1950). Learning activities

promote internalization of the subject as one progresses through the curriculum.

Information on placement in curricula revealed that in the opinions of the respondents, sports nutrition is a viable elective for dietetics majors and for non-majors. However, requiring sports nutrition for dietetics majors was favored by only 55.5% of respondents. The respondents agreed that the prerequisite of a basic nutrition course for non-majors is essential. The course level for dietetics majors recommended was an undergraduate course elective. The level recommended for non-majors was also undergraduate.

Conclusions

Based on the results of this study, SCAN members provide valuable information on curriculum needs, with consistency in opinions exhibited regardless of education level, recency of education, or dietetic practice area. This population may be helpful in the future in providing insight in the nutrition education needs of athletes.

Topics appropriate for a sports nutrition curriculum centered around the concepts of normal nutrition, with specific nutrient needs of athletes targeted. Because of the lack of significant differences in opinions based on education level, recency of education, or practice area, it is concluded that, in general, SCAN members are in agreement about athletes' dietary needs.

The most important learning activity cited was research review, therefore, it is concluded that SCAN members recog-

nize the importance of continued review of research in order to be cognizant of recent findings. Nutrition as a science is a fairly new field, with current research frequently changing dietary recommendations. SCAN members exhibited awareness of the importance of advice based on the most recent scientific evidence.

Learning activities should also emphasize the practical aspects of nutrition. Theory-based information must be interpreted for the lay person, with practical methods of implementing recommendations made. Internalization of the concepts occurs with a variety of learning activities. The respondents recognize this fact in that the majority of the learning activities were practical ones, using problem-solving as a method of internalizing the information.

Recommendations

The study was undertaken to identify appropriate topics and learning experiences for a sports nutrition curriculum and to assess the importance of the topics. Recommendations for sports nutrition curricula follow.

1. Placement of sports nutrition in the home economics curriculum should be at the undergraduate level, as an elective for both majors and non-majors, with 84.2% of the respondents agreeing that a basic nutrition course should be a prerequisite. Of the 97.5% of respondents recommending sports nutrition as a valuable course in dietetics, 46% indicated placement as an undergraduate course elective for

majors. With respect to non-majors, 79.7% indicated that placement was appropriate at the undergraduate level. Further research may focus on the integration of sports nutrition in the basic nutrition curriculum. The title of "Sports Nutrition" was considered to be suitable. Of the other titles suggested, nutrient needs in exercise was emphasized.

2. It is recommended that the sports nutrition curriculum revolve around the general concepts of the principles of normal nutrition, focusing on the biochemical aspects of metabolism as these broad topics were identified through research in the top five topics appropriate for sports nutrition.

3. Specific concepts to be highlighted in the sports nutrition curriculum are fluid and hydration state, carbohydrate needs, and pre-post-during competition eating. These three topics were ranked in the top five topics along with normal nutrition and the biochemical aspects of metabolism. They address the most important aspects of sports nutrition and could be utilized as the core components of a course or as the basis for a workshop.

4. Additional concepts to be covered include translating nutrient needs into meal plans, protein needs, accurate sources of nutrition information, nutrient needs during exercise, and weight control. These topics were six through ten in the ranking. They suggest practical application of normal nutrition information needed by athletes. As time allows, these concepts may be included in curricula.

5. Learning activities should be based on research review, the number one activity as ranked by respondents. Other activities, as ranked by respondents, should include application in practical areas, such as label reading and menu selection. Creating awareness of one's dietary habits through intake diaries and computerized dietary analysis are recommended in order to allow students to realize the need for behavior change. Providing practical suggestions and methods of change may be beneficial.

6. Class format or delivery should include lecture, group discussion, and hands-on activities. Activities with athletes are recommended. Such activities should focus on dietary intake of athletes and training schedules which affect nutrient need and patterns of intake. If research participation is available, it is also recommended. The respondents' major format preference was lecture, with the second as hands-on activities. This result emphasizes the need for hands-on, practical application.

Implications

The findings and conclusions of the study lead the researcher to make the following statements with respect to the planning of a sports nutrition curriculum.

1. Nutrition instructors can use the concepts and learning activities identified in planning a sports nutrition curriculum or revising existing courses or workshop formats. One course or several courses may be developed,

with topical outlines based on the topic identification. Several sequential courses may be planned based on the topics identified. Early courses should revolve around basic nutrition, with advanced courses investigating the more specific nutrient needs of athletes.

Classroom instructors, extension personnel, SCAN members, or dietitians in consultant and community nutrition education could use the information in planning educational activities. The concepts and learning activities may also be utilized in nutrition education materials such as books, study guides, independent modules, or curriculum guides.

2. There may be a need for preparation of potential teachers of sports nutrition as 59.9% of the respondents indicated an interest in teaching. However, only 43% reported previously participating in a sports nutrition course. Institutions of higher education may offer graduate level courses or workshops in order to prepare future teachers. SCAN may also need to offer more workshops to Registered Dietitians on sports nutrition in the future.

3. Interest in sports nutrition may provide a need for a specialization within the home economics curriculum in the future. The documented need for sports nutrition (97.5% of respondents agree), as well as the problems encountered with inaccurate information, myths, and misconceptions indicate that nutritionists target athletes as potential learners. Accreditation of sports nutritionists by the American Dietetic Association may be investigated.

REFERENCES

Accreditation/Approval Manual for Dietetic Education Programs. (1991). Chicago: American Dietetic Association.

Anderson, E.P. and Brands, M.F. (1990). The "real" home economics curriculum. Illinois Teacher, 23(5), 172-173.

Balaban, E.P., Cox, J.V., Snell, P., Vaughn, R.H. and Frenkel, E.P. (1989). The frequency of anemia and iron deficiency in the runner. Medicine and Science in Sports and Exercise, 21(6), 643-648.

Barr, S.I. (1987). Nutrition knowledge of female varsity athletes and university students. Journal of the American Dietetic Association, 87(12), 1660-1664.

Best, J.W. and Kahn, J.V. (1986). Research in Education. Englewood Cliffs: Prentice-Hall.

Borgen, J.S., Corbin, C.B., (1987). Eating disorders among female athletes. The Physician and Sportsmedicine, 15 (2), 88-95.

Brotherhood, J.R. (1984). Nutrition and sports performance. Sports Medicine 1, 351-389.

Brown, M. and Paolucci, B. (1979). Home Economics A Definition. Washington, D.C.: American Home Economics Association.

Brownell, K.D., Rodin, J. and Wilmore, J.H. (1992). Eating, Body Weight, and Performance in Athletes: Disorders of Modern Society. Philadelphia: Lea and Febiger.

Brownell, K.D. and Steen, S.N. (1992). Weight Cycling in athletes: effects on behavior, physiology, and health. In Brownell, K.D., Rodin, J., and Wilmore, J.H. (Eds.), Eating, Body Weight, and Performance of Athletes: Disorders of Modern Society, (pp. 159-171). Philadelphia: Lea and Febiger.

Bruner, J.S. (1966). Toward a Theory of Instruction. Cambridge, Mass.: Belknap Press of Harvard University.

Buskirk, E.R. (1990). Exercise. In Brown, M.L. (Ed.) Present Knowledge in Nutrition. Washington, DC: International Life Sciences Institute.

Butterfield, G.E. and Calloway, D.H. (1984). Physical activity improves protein utilization in young men. British Journal of Nutrition, 51, 171-184.

Butterfield, G.E. (1987). Whole body protein utilization in humans. Medicine and Science in Sports and Exercise, 19(5), S157-S165.

Clark, K.L. (1991). Reaching out to SCAN members across the nation. SCAN's Pulse. Chicago: American Dietetic Association.

Clark, N., Nelson, M. and Evans, W. (1988). Nutrition education for elite female runners. The Physician and Sportsmedicine, 16(2), 124-136.

Coleman, E. (1991). Carbohydrates: The master fuel. In Berning, J.R. and Steen, S.N. (Eds.), Sports Nutrition for the 90's, (pp. 31-52). Gaithersburg, MD: Aspen.

Concepts and Generalizations: Their Place in High School Home Economics Curriculum Development. (1967). Washington, D.C.: American Home Economics Association.

Corley, G., Demarest-Litchford, M. and Bazzarre, T.L. (1990). Nutrition knowledge and dietary practices of college coaches. Journal of the American Dietetic Association, 90(5), 705-709.

Costill, D. (1991). Sports nutrition: the state of the art. Mars Food For Life Performance, 1, (1), 1-2.

Coyle, E.F. (1988). Carbohydrates and athletic performance. Sports Science Exchange, 1(7), 1-4.

Directory of Dietetic Programs 1991-1992. (1991). Chicago: American Dietetic Association.

Douglas, P.D. and Douglas, J.G. (1984). Nutrition knowledge and food practices of high school athletes. Journal of the American Dietetic Association, 84(10), 1198-1202.

Drinkwater, B. (1992). Amenorrhea, body weight, and osteoporosis. In Brownell, K.D., Rodin, J., and Wilmore, J.H., Eating, Body Weight, and Performance in Athletes: Disorders of Modern Society (pp. 235-247), Philadelphia: Lea and Febiger.

Essen, B. (1977). Intramuscular substrate utilization during prolonged exercise. Annals of the New York Academy of Sciences, 301, 30-44.

Evans, W.J. and Hughes, V.A. (1985). Dietary carbohydrates and endurance exercise. The American Journal of Clinical Nutrition, 41, 1146-1154.

Food labeling; Advance notice of proposed rulemaking. (1989). Federal Register (DHHS Publication No. 241-279/05411). Washington, D.C.: U.S. Government Printing Office.

Gillespie, A.H. (1987). Communication theory as a basis for nutrition education. Journal of the American Dietetic Association, 87(Suppl), S-44.

Grandjean, A.C. (1989a). Disseminating sports nutrition research information: One sports nutritionists perspective. In Report of the Ross Symposium on The Theory and Practice of Athletic Nutrition: Bridging the Gap (pp. ix-x). Columbus, OH: Ross Laboratories.

Grandjean, A.C. (1989b). Macronutrient intake of U.S. athletes compared with the general population and recommendations made for athletes. American Journal of Clinical Nutrition, 49, 1070-1076.

Grant, A. and DeHoog, S. (1991). Nutritional Assessment and Support. Seattle, WA: Anne Grant, Susan DeHoog.

Graves, K.L., Farthing, M.C., Smith, S.A., and Turchi, J.M. (1991). Nutrition training, attitudes, knowledge, recommendations, responsibility, and resource utilization of high school coaches and trainers. Journal of the American Dietetic Association, 91(3), 321-324.

Hannay, L.M. and Seller, W. (1991). The curriculum leadership role in facilitating curriculum deliberation. Journal of Curriculum and Supervision 6(4), 340-357.

Hickson, J.F., Wolinsky, I., Pivarnik, J.M., Neuman, E.A., Itak, J.F. and Stockton, J.E. (1987). Nutritional profile of football athletes eating from a training table. Nutrition Research, 1, 27-34.

Home Economics Concepts: A Base for Curriculum Development. (1989). Alexandria, VA: American Home Economics Association.

Houck, J. and Slavin, J. (1991). Protein nutrition for the athlete. In Berning, J.R. and Steen, S.N. (Eds.), Sports Nutrition for the 90's (pp. 1-11). Gaithersburg, MD: Aspen.

Hultman, E., Thomson, J.A., and Harris, R.C. (1988). Work and exercise. In Shils, M.E. and Young, V.R. (Eds.), Modern Nutrition in Health and Disease (pp.1001-1022) Philadelphia: Lea and Febiger.

Johnson, D.W. and Johnson, R. T. (1985). Nutrition education: A model for effectiveness, A synthesis of research. Journal of Nutrition Education, 17(2), 5-6.

Joseph, M.L. and Joseph, W.D. (1986). Research Fundamentals in Home Economics. Redondo Beach: Plycon Press.

Kant, A.K., Schatzkin, A., Block, G., Ziegler, R.G. and Nestle, M. (1991). Food group intake patterns and associated nutrient profiles of the U.S. population. Journal of the American Dietetic Association, 91(12), 1532-1537.

Keith, R.E., O'Keefe, K.A., Blessing, D.L., and Wilson, G.D. (1991). Alterations in dietary carbohydrate, protein, and fat intake and mood state in trained female cyclists. Medicine and Science in Sports and Exercise, 23, 212-217.

Kiess, H.O. (1989). Statistical Concepts for the Behavioral Sciences. Boston: Allyn & Bacon.

Kris-Etherton, P.M. (1990). Nutrition and athletic performance. Nutrition Today, 35-37.

Lemon, P.W.R., Dolny, D.G. and Yarasheski, K.E. (1984). Effect of intensity on protein utilization during prolonged exercise. Medicine and Science in Sports and Exercise, 16, p. 151.

Lukaski, H.C., Bolonchuk, W.W., Klevay, L.M., Mahalko, J.R., Milne, D.B., and Sandstead, H.H. (1984). Influence of type and amount of dietary lipid concentrations in endurance athletes. American Journal of Clinical Nutrition, 39, 35-44.

Lyle, B.J. and Forgac, T. (1991). Hydration and fluid replacement. In Berning, J.R. and Steen, S.N. (Eds.), Sports Nutrition for the 90's (pp. 175-193). Gaithersburg, MD: Aspen.

Marcus, J.B. (1986). Sports Nutrition. Chicago: American Dietetic Association.

Member Handbook. (1990). Chicago: American Dietetic Association.

Moses, K. and Manore, M.M. (1991). Development and testing of a carbohydrate monitoring tool for athletes. Journal of the American Dietetic Association, 91(8) 962-965.

Nelson, M.E., Fisher, E.C., Catsos, P.D., Meredith, C.N., Turksoy, R.N., and Evans, W.J. (1986). Diet and bone status in amenorrheic runners. American Journal of Clinical Nutrition, 43, 910-916.

Newmark, S.R., Toppo, F.R., and Adams, G. (1991). Fluid and electrolyte replacement in the ultramarathon runner. American Journal of Sports Medicine, 19(4), 389-391.

Niemuth, P.E., Lane-Larsen, C.L., Meisterling, R.C., Wadsworth, T., Cummings, M., and Holtmeier, K. (1991, October). Weight gain in high school athletes through nutrition intervention and its affect on athletic performance parameters. Paper presented at the annual meeting of the American Dietetic Association: Dallas, TX.

O'Keefe, K.A., Keith, R.E., Wilson, G.D., and Blessing, D.L. (1989). Dietary carbohydrate intake and endurance exercise performance of trained female cyclists. Nutrition Research, 9, 819-830.

Oliva, P.T. (1988). Developing the Curriculum. Glenview, Illinois: Scott, Foresman and Co.

Pomeroy, C. and Mitchell, J.E. (1992). Medical issues in the eating disorders. In Brownell, K.D., Rodin, J. and Wilmore, J.H. (Eds.), Eating, Body Weight, and Performance of Athletes: Disorders of Modern Society, (pp. 202-221). Philadelphia: Lea and Febiger.

Potter, G.S. and Wood, O.B. (1991). Comparison of self and group instruction for teaching sports nutrition to college athletes. Journal of Nutrition Education, 23(6), 288-290.

Roberts, W.O. and Elliot, D.L. (1991). Malnutrition in a compulsive runner: A case conference. Medicine and Science in Sports and Exercise, 23(5), 513-516.

Sherman, W.M., Peden, M.C., and Wright, D.A. (1991). Carbohydrate feedings one hour before exercise improves cycling performance. American Journal of Clinical Nutrition, 54, 866-870.

Short, S. and Short, W.R. (1983). Four year study of university athletes' dietary intake. Journal of the American Dietetic Association, 82(6), 632-645.

Skinner, J.D. (1991). Changes in students' dietary behavior during a college nutrition course. Journal of Nutrition Education, 23(2), 72-75.

Slavin, J.L. (1991). Assessing athletes nutritional status. The Physician and Sportsmedicine, 19(11), 79-91.

Smith, N.J. (1976). Food for Sport. Palo Alto: Bull.

Storlie, J. (1989). Defining the gaps: An overview. In Report of the Ross Symposium on The Theory and Practice of Athletic Nutrition: Bridging the Gap (pp. vii-viii). Columbus, OH: Ross Laboratories.

The Surgeon General's Report on Nutrition and Health. (1988). (DHHS Publication No. 88-50210). Washington, DC: U.S. Government Printing Office.

Thornton, J.S. (1989). Carboloading and endurance: A new look. The Physician and Sportsmedicine, 17(10), 149-156.

Thornton, J.D. (1990). How can you tell when an athlete is too thin? Physician and Sportsmedicine, 18(12), 124-133.

Touliatos, J. and Compton, N.H. (1988). Research in Human Ecology/Home Economics. Ames: Iowa State Press.

Tyler, R. W. (1950). Basic Principles of Curriculum and Instruction. Chicago: The University of Chicago Press.

Updegrove, N.A. and Achterberg, C.L. (1991). The conceptual relationship between training and eating in high school distance runners. Journal of Nutrition Education, 23(), 18-24.

Whitmire, D. (1991). Vitamins and minerals: A perspective in physical performance. In Berning, J.R. and Steen, S.N. (Eds.) Sports Nutrition for the 90's (pp. 129-148). Gaithersburg, MD.: Aspen.

Williams, M.H. (1989). Nutritional erogenic aids and athletic performance. Nutrition Today, 7-14.

Williams, M.H. (1991). Ergogenic aids. In Berning, J.R. and Steen, S.N. (Eds.). Sports Nutrition for the 90's (pp. 101-128). Gaithersburg, MD: Aspen.

Wilmore, J.H. (1992). Body weight and body composition. In Brownell, K.D., Rodin, J.R., and Wilmore, J.H. (Eds.). Eating, Body Weight, and Performance in Athletes: Disorders of Modern Society (pp. 77-93). Philadelphia: Lea and Febiger.

Wilmore, J.H. and Costill, D.L. (1992). Nutrition and human performance. In Brownell, K.D., Rodin, J.R., and Wilmore, J.H. (Eds.) Eating, Body Weight and Performance in Athletes: Disorders of Modern Society (pp. 61-76). Philadelphia: Lea and Febiger.

Yoshimura, H.T., Inoue, T., Yamada, T., and Shiraki, K. (1980). Anemia during hard physical training (sports anemia) and its causal mechanism with special reference to protein nutrition. World Review of Nutrition and Diet, 35, 1-85.

APPENDIX A

INSTRUMENT AND LETTER

Oklahoma State University

ACADEMIC AFFAIRS AND STUDENT SERVICES
COLLEGE OF HOME ECONOMICS

STILLWATER OKLAHOMA 74078-0337
HOME ECONOMICS 113
405-744-5056

November 12, 1991

Dear SCAN Member:

Sports nutrition is of tremendous interest today. Effective education in this area must successfully communicate nutrition facts as well as combat myths and erroneous information pervading the field. Your input on appropriate topics and recommendations for successful learning activities is needed.

Please take fifteen minutes to complete the questionnaire and return in the enclosed envelope. Your input is vital in designing future curriculum plans in sports nutrition.

Thank you!

Sincerely,

Melissa M. Shock
Melissa M. Shock, M.S., R.D.
Graduate Student

Elaine Jorgenson
Elaine Jorgenson, Ed.D., C.H.E.
Advisor

MS/EJ:nh

SPORTS NUTRITION CURRICULUM SURVEY

Directions: Please circle the number representing your answers to the following questions.

Personal Information

1. Are you a Registered Dietitian?
   1. yes 2. no

2. What is your gender?
   1. male 2. female

3. What is your highest level of education?
   1. bachelor's 3. specialist 5. other, please
   2. master's 4. doctorate specify _____

4. How recently did you complete your highest level of education?
   1. less than 1 year 3. 6-10 years 5. over 15 years
   2. 1-5 years 4. 11-15 years

5. How many years of work experience do you have in dietetics?
   1. less than 1 year 3. 6-10 years 5. over 15 years
   2. 1-5 years 4. 11-15 years

6. What is the dietetic practice area that best characterizes your primary position?
   1. clinical dietetics 4. community dietetics
   2. management practices 5. education/research
   3. consultation/private practice 6. fitness/wellness

Sports Nutrition in the Curriculum

7. Have you taken a sports nutrition course?
   1. yes 2. no

8. If your answer to number 7 is yes, at what level was it?
   1. undergraduate 3. post-graduate workshop
   2. graduate

9. Have you taught a sports nutrition course or workshop?
   1. yes 2. no, skip to #11

10. If your answer to number 9 is yes, at what level was it?
    1. undergraduate 3. post-graduate workshop
    2. graduate

11. In your opinion, is a sports nutrition course a potentially valuable addition to the dietetics curriculum as an elective for majors?
    1. yes 2. no
12. In your opinion, is a sports nutrition course a potentially valuable addition to the dietetics curriculum as a requirement for majors?
    1. yes 2. no, skip to #15

13. In consideration of sports nutrition as a course for dietetics majors, when would it be most valuable?
    1. undergraduate course elective
    2. undergraduate course requirement
    3. graduate course
    4. workshop, how many hours?_____

14. In consideration of sports nutrition as a course for dietetics majors, at what level would it be most valuable?
    1. undergraduate, lower division
    2. undergraduate, upper division
    3. graduate level
    4. workshop

15. In your opinion, is a sports nutrition course a potentially valuable addition to the dietetics curriculum as an elective for non-majors?
    1. yes 2. no, skip to #18

16. In consideration of sports nutrition as an elective for non-majors, when would it be most valuable?
    1. undergraduate course elective
    2. graduate course
    3. workshop, how many hours? _____

17. Should an introductory course in human nutrition be a prerequisite for a sports nutrition course for non-majors?
    1. yes 2. no

Teaching Sports Nutrition

Assuming that sports nutrition is going to be taught:

18. Are you interested in teaching a sports nutrition course or workshop?
    1. yes 2. no

19. What type of class format or delivery do you believe to be most appropriate for a sports nutrition course? (Circle all appropriate answers.)
    1. lecture
    2. group discussion
    3. hands-on activities
    4. research participation

20. What is an appropriate title for a course in sports nutrition?_____

21. What learning activities are important for non-majors in sports nutrition? Please rate the activities according to their level of importance to you. The rating scale follows.

1 = no importance 2= limited importance 3 = moderate importance
4 = considerable importance 5 = essential

1. food intake diaries	1 2 3 4 5
2. food frequency questionnaires	1 2 3 4 5
3. computer-assisted dietary analysis	1 2 3 4 5
4. food preparation techniques	1 2 3 4 5
5. use of the Exchange System	1 2 3 4 5
6. individual case studies	1 2 3 4 5
7. review of current sports nutrition research	1 2 3 4 5
8. menu selection	1 2 3 4 5
9. label reading	1 2 3 4 5
10. research projects	1 2 3 4 5

Please list other activities to include.

1. _____

2. _____

3. _____

Please go to the next page.

22. The following curriculum topics have been identified through a review of literature as appropriate for sports nutrition. Assuming that the student has no nutrition training, please rate the topics according to their level of importance to you. The rating scale follows.

1 = limited importance 3 = considerable importance
2 = moderate importance 4 = essential

Basic four food groups	1 2 3 4
Biochemical aspects of metabolism	1 2 3 4
Calcium and osteopororis	1 2 3 4
Carbohydrate needs in exercise	1 2 3 4
Dietary Guidelines	1 2 3 4
Eating disorders	1 2 3 4
Eating away from home	1 2 3 4
Electrolyte replacement after exercise	1 2 3 4
Ergogenic aids	1 2 3 4
Exchange system	1 2 3 4
Fluid replacement during/after exercise	1 2 3 4
Food preparation techniques	1 2 3 4
Iron-deficiency anemia	1 2 3 4
Label reading	1 2 3 4
Liquid meals	1 2 3 4
Mineral needs during exercise	1 2 3 4
Nutrition and cancer	1 2 3 4
Nutrition and cardiovascular disease	1 2 3 4
Nutrition and weight control	1 2 3 4
Nutritional assessment	1 2 3 4
Pre/Post/During competition eating	1 2 3 4
Principles of normal nutrition	1 2 3 4
Protein needs during exercise	1 2 3 4
Sources of accurate nutrition information	1 2 3 4
Sports drinks	1 2 3 4
Translating nutrient needs into food	1 2 3 4
Vitamin and mineral supplements	1 2 3 4
Vitamin needs during exercise	1 2 3 4

Please indicate any additional topics which should be included.

1. _____

2. _____

3. _____

4. _____

5. _____

Please list the five (5) topics which are most important to you in the sports nutrition curriculum.

1. _____

2. _____

3. _____

4. _____

5. _____

THANK YOU FOR YOUR PARTICIPATION!

Please return return in the enclosed envelope to:

Melissa Shock, M.S., R.D.
21 Rebecca Lane
Conway, AR 72032

APPENDIX B

RECOMMENDATIONS FROM RESPONDENTS

SUGGESTIONS FOR TEACHING SPORTS NUTRITION

1. Involvement with athletes.
2. Keep exercise diaries.
3. Evaluation of sports foods, fads.
4. Use nutritional assessment techniques.
5. Learn energy expenditure measures.
6. Lab on fluid/weight loss in exercise.
7. Field trip to restaurant for menu selection
8. Interview athlete about diet.
9. Identify misinformation.
10. Lab on lowering fat in menus.
11. Field trip to grocery store for label reading.
12. Measure oxygen consumption with high fat diets.
13. Review sports nutrition education sets.
14. Assess sports training regimens.
15. Assess coaches' intake vs. team intake.
16. Develop a dietary guide for parents.
17. Develop a personalized plan for a sport.
18. Discuss current practices among athletes.
19. Measure biochemical parameters.
20. Lab on food portion sizes.
21. Writing for the media.
22. Meet with coaches, trainers, athletes.
23. Intern at a sports center.
24. Determine fat/calorie levels in foods.
25. Critical analysis of lay articles.
26. Food demonstrations.
27. Weight control applications.
28. Menu planning for high carbohydrate diets.
29. Analysis of calorie expenditures.
30. Develop resources for coaches/teachers.
31. Learn to communicate with athletes.
32. Encourage motivation techniques/strategies.

ADDITIONAL TOPICS SUGGESTED BY RESPONDENTS

1. Problem Identification
2. Training vs. Competition Nutrition
3. Sport Specific Concerns
4. Fat in the Diet
5. Body Image and Food Control
6. The Weekend Athlete's Needs
7. Injury & Recovery Nutrition
8. Weight Loss With Lean Mass Retention
9. Special Needs of Female Athletes
10. Diet and High Altitude
11. Pregnancy and Exercise
12. Referral System to the R.D.
13. Exercise Science Terms
14. Dehydration
15. Protein Powder
16. Steroid Use in Athletes
17. Fad Products for Sports Nutrition
18. Effects of Alcohol
19. The Teen Athlete's Needs
20. Body Composition
21. Myths of Sports Nutrition
22. Hazardous Practices
23. Guidelines of Good Research
24. Relation to Exercise Physiology
25. Nutrition in Aging
26. Healthy Snacks
27. Eating on the Run
28. Nutrition and Stress
29. Sociology--what kids are coming from
30. Adapting Intake to Training
31. Nutrition and Pregnancy

VITA

Melissa Moore Shock

Candidate for the Degree of

Doctor of Philosophy

Thesis: DEVELOPMENT OF A CONCEPT-BASED SPORTS NUTRITION CURRICULUM

Major Field: Home Economics

Biographical:

Personal Data: Born in El Dorado, Arkansas, October 4, 1948, the daughter of Philip A. and Janie Redick Moore. Wife of Michael C. Shock, mother of Matthew M. Shock and Marcus S. Shock.

Education: Graduated from El Dorado High School in 1966; attended Hendrix College, Conway, Arkansas; received Bachelor of Science in Education degree from the University of Arkansas, Fayetteville, Arkansas, 1970; received Master of Science in Education degree from the University of Central Arkansas, 1984; received the Certified Home Economist Credential, 1986; completed the requirements for the Registered Dietitian credential through the American Dietetic Association, 1989; completed requirements for the Doctor of Philosophy degree at Oklahoma State University, May, 1992.

Professional Experience: Home Economist, Dallas Power and Light Company, Dallas, Texas, 1970-1971; Home Economics Teacher, McClellan High School Little Rock, Arkansas 1971-1974; Instructor of Home Economics, University of Central Arkansas, 1985-present.

Professional Organizations: American Home Economics Association; Arkansas Home Economics Association; American Dietetic Association; Arkansas Dietetic Association; Phi Upsilon Omicron; Kappa Delta Pi.